California Regional Water Quality Control Board
Santa Ana Region

DRAFT

Staff Report on the Sediment Total Maximum Daily Loads for Big Bear Lake and Rathbun Creek

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July 11, 2005

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Described within this document are the proposed Total Maximum Daily Loads (TMDLs) for sedimentation for Big Bear Lake and Rathbun Creek. Section 303(d) of the Clean Water Act (CWA) requires States to identify waters that do not or are not expected to meet water quality standards (beneficial uses, water quality objectives and the state's antidegradation policy) with technology-based controls. The States are then required to develop a TMDL for each of the constituents listed on the 303(d) list. The TMDL establishes the maximum load of a pollutant that can enter the listed water body without violating water quality standards. A TMDL is defined as the sum of individual wasteload allocations for point sources, load allocations for nonpoint sources including natural background, and a margin of safety. Seasonal variations and critical conditions must also be addressed. The Regional Board placed Big Bear Lake and Rathbun (Rathbone) Creek on the 303(d) list in 1994 due to sedimentation/siltation. The listings were based on historic information summarized in Section 2.2. Sedimentation due to erosion within the watershed or to organic matter deposition in the lake affects the lake's designated beneficial uses. Excessive sediment deposition in Big Bear Lake has resulted in a decrease in lake capacity, which directly affects municipal, habitat and recreational beneficial uses. It has also contributed to the eutrophic condition of the lake by reducing depths and increasing light and substrate available for macrophyte colonization and growth. Sediments also contribute nutrients that are the direct cause of eutrophication. Phosphorus sorbs to soil particles and is transported to surface waters via eroded sediments. Inorganic nitrogen is transported in surface water runoff in both dissolved and particulate forms. Sedimentation of nutrients also occurs with deposition of organic matter, including animal wastes and decaying plant matter. The eutrophication problem in the lake is being addressed in separate nutrient TMDLs. However, because of the relationship between sedimentation/siltation and nutrient inputs, the sediment TMDLs proposed herein are linked to the nutrient TMDLs. By reducing sediment loading to the lake in response to the proposed TMDLs, nutrient loads should be reduced as well. The nutrient TMDLs call for reductions in in-lake organic matter (macrophytes and algae). Presumably, these reductions will also result in decreases in sedimentation.

Summarized within this document is information used by the California Regional Water Quality Control Board, Santa Ana Region (Regional Board) to develop the proposed TMDLs for sedimentation/siltation for Big Bear Lake and Rathbun Creek. The components of the Big Bear Lake and Ratbhun Creek sedimentation/siltation TMDLs include:

1. Problem Statement. This section reviews the historic information used to include Big Bear Lake and Rathbun Creek on the 303(d) list, and evaluates data collected since the listing. Narrative water quality objectives for solids, suspended and settleable, are not currently being met because sedimentation/siltation has decreased the lake's capacity and has contributed to excessive plant growth in shallow areas, impacting the lake's recreation and freshwater habitats. Rathbun Creek is a main contributor of sediment to the lake and has been modified, which has led to erosion problems within the creek itself.

2. Numeric Targets. The proposed numeric targets for Big Bear Lake and Rathbun Creek include mass-based loads. The recommended numeric target for sediment for Big Bear Lake was calculated using sediment yields from forest north and forest south land uses and multiplying these yields by the total area of north facing slopes and south facing slopes for the entire watershed area to obtain a total sediment load. This total sediment load is that which would be expected absent anthropogenic activities in the watershed, assuming that the sediment load from forest land uses represents natural background conditions. In this watershed, this assumption may

not represent actual conditions. The numeric target for sediment for Rathbun Creek was calculated using the same methodology, except that the sediment yields were multiplied by the Rathbun Creek subwatershed area. In addition to mass-based loads, other numeric and/or narrative indicators for Big Bear Lake and Rathbun Creek are proposed (Tables 3-1 and 3-2). For Big Bear Lake, these include a 5% increase in lake capacity within 10 years. For Rathbun Creek, targets based on turbidity and benthic macroinvertebrates are also identified.

3. Source Analysis. This section quantitatively evaluates all sources of sediment to Big Bear Lake and Rathbun Creek. The sources are subdivided into nonpoint and point sources, as an average over a 14-year period (1990 to 2003) (Tables 4-2, 4-3 and 4-4). External inputs from various land uses were simulated using the Hydrological Simulation Program Fortran (HSPF) model and are summarized for 1990-2003. For Big Bear Lake and Rathbun Creek, external nonpoint source inputs are from forest and resort land uses (Tables 4-3 and 4-4); external point source inputs are from high density urban and residential runoff subject to NPDES permits (Tables 4-3 and 4-4).

4. Linkage Analysis and TMDLs. The linkage analysis for Big Bear Lake and Rathbun Creek discusses the relationship between watershed loads and effects on beneficial uses. The loading capacities (TMDLs) for sediment for Big Bear Lake and Rathbun Creek are shown in Tables 5-1 and 5-2.

5. TMDL Allocations. The only point sources in the watershed are urban runoff (residential and high density urban land uses) subject to NPDES permits. Proposed wasteload allocations for the Big Bear Lake and Rathbun Creek sediment TMDLs are shown in Tables 6-1 and 6-2. Load allocations for sediment are proposed for nonpoint source categories (forest and resort) after application of Best Management Practices (Tables 6-1 and 6-2). The proposed WLAs and LAs are expressed as 10-yr running averages.

6. Seasonal Variation and Critical Conditions. There are inherent seasonal (and annual variations) in the delivery of sediment. To address this variability, annual average sediment loads from each significant source were simulated for a 14-year period (1990-2003), which incorporates all types of seasonal/hydrological conditions. These results are the basis of the proposed targets, TMDLs, WLAs and LAs. In addition, the numeric sediment targets, TMDLs, WLAs and LAs are proposed as 10-year running averages to take annual variability into account. The proposed lake capacity target requires improvement in lake capacity over time, despite seasonal, climatic or other variations in sediment loading.

Consideration of critical conditions ensures that even under the worst water quality conditions, water quality standards can still be met through loads established in the TMDLs. Critical conditions for sediment include events, such as storms, that result in the erosion and transport of sediment and immediate adverse impacts on beneficial uses (e.g., removal or covering of spawning substrate). Reasonably feasible control measures must be implemented to address such inputs. Compliance with the proposed numeric targets, TMDLs WLAs and LAs will require the implementation of such measures. However, the adverse effects of erosion/sedimentation continue to be felt over the long-term, unless the sediment is removed. The effects of the loss of lake capacity in Big Bear Lake are most pronounced during the spring and summer of dry years, when the level of the lake declines and water levels are shallower. Recreational use of the lake is typically at its peak during these months and this is also the period of macrophyte growth. The sediment TMDLs for Big Bear Lake and Rathbun Creek address the dry period critical conditions by specifying alternative numeric targets, including a lake capacity target for Big Bear Lake and benthic macroinvertebrate metrics for Rathbun Creek. In addition, the proposed implementation

plan includes a requirement for the development of a lake management plan that is to identify an overall sediment control and management strategy designed to restore and protect beneficial uses, including during the critical dry periods.

7. Margin of Safety. The TMDLs contain an explicit margin of safety of 10%. An explicit MOS was used to account for uncertainties in the calculated total sediment load and assumptions made about the delivery of sediment to the sedimentation basins in Rathbun Creek.

8. Implementation Plan. This section describes the actions, regulatory tools and other measures necessary to achieve the wasteload and load allocations as specified in the TMDLs. Implementation of the proposed Big Bear Lake and Rathbun Creek TMDLs are the responsibility of the United States Forest Service (USFS), the Big Bear Mountain Resorts, the City of Big Bear Lake, the California Department of Transportation (Caltrans), the County of San Bernardino and the San Bernardino County Flood Control District (SBCFCD). The Big Bear Municipal Water District must be a cooperating partner working with the local stakeholders to implement the Big Bear Lake sediment TMDL, given the District's significant responsibilities for management of the lake. Attainment of the final numeric targets is projected to occur within 15 years of final approval of the TMDLs (i.e., no later than 2020).

9. Monitoring Plan. In order to evaluate the effectiveness of actions and programs implemented pursuant to the TMDLs, continuation of the existing watershed and lake water quality monitoring programs (with some modifications), as well as some additional monitoring elements, is a part of the recommended implementation plan. Because the proposed TMDLs are phased, follow-up monitoring and evaluation is essential to validate and revise the TMDLs as necessary.

1.0 INTRODUCTION

The proposed TMDLs for sedimentation/siltation for Big Bear Lake and Rathbun Creek are described in this document. Big Bear Lake and Rathbun Creek were placed on the 303(d) list in 1994 for sedimentation/siltation. The following paragraphs provide an introduction to the history of Big Bear Lake.

Big Bear Lake is a man-made reservoir created by the construction of Bear Valley Dam in 1883-84. The lake is located in the San Bernardino Mountains in San Bernardino County, approximately 100 miles northeast of Los Angeles and 40 miles northeast of the City of San Bernardino. It is the dominant feature of Big Bear Valley and its eastern area covers what was once a large flat meadow (Leidy 2003, 6-11).

Frank E. Brown constructed the first dam in 1883-84 as a single arch dam across Bear Creek, a tributary of the Santa Ana River. During 1912, a 20-foot higher, multiple arch dam was completed downstream of the existing dam (Leidy 2003, 12-16). These dams were constructed to store water for downstream irrigation uses in the Redlands/San Bernardino area.

In 1964, the Big Bear Municipal Water District (BBMWD) was created in an effort to develop programs and projects to stabilize the lake's water level. BBMWD is directed by a five-member elected Board of Directors. BBMWD's primary responsibility is the day-to-day management of Big Bear Lake, including the management of water releases, Bear Valley dam, recreation, and fisheries and wildlife. In January 1977, BBMWD acquired the title to the dam, the lake bottom, and the surface recreation rights of Big Bear Lake, for a purchase price of $4,700,000. Bear Valley Mutual Water Company (Mutual), which manages the distribution of lake water to downstream irrigation users, retained the water rights to Big Bear Lake (BBMWD 2002). Mutual provides Big Bear Lake water as a source of domestic supply for users within its service area. BBMWD must provide Mutual with 65,000 acre-feet (af) of water in any rolling ten-year period. When Mutual needs water above this amount, BBMWD has several options. BBMWD can release water from the lake, or provide water from another source (i.e., groundwater or State Water Project)(BBMWD 2002).

Big Bear Lake has a storage capacity of 73,320 acre-feet (af) and a water surface area of 2,971 acres at the elevation of the top of the dam (6743.2 feet). The lake is full at a gage height reading of 72.33 feet (Big Bear Watermaster 2001, 6). In order to maintain recreational and wildlife uses of the lake, especially at the east end and other shallow areas, BBMWD implements a Lake Stabilization Program designed to stabilize Big Bear Lake within 15 feet of the dam elevation (i.e., in the range of 6728.2-6743.2 feet) over the long-term (BBMWD 2002). Recreational uses of the lake are severely impacted if the lake level falls more than 15 feet (i.e., lake elevation of 6728.2 feet). Water levels have been measured continuously since July 1998 with the installation of a continuous lake level recorder by the BBMWD (Big Bear Watermaster 2001, 5). During most years, the lake level fluctuates no more than 3-5 feet, but during drought conditions, when little surface runoff from the surrounding watershed enters Big Bear Lake, the lake levels can fluctuate up to 15 feet. High evaporation levels, due to high wind and low humidity conditions, can remove up to 48 inches per year from the lake surface. This number varies seasonally, depending on temperature, lake level (and thus surface area), and other factors. Evaporation is calculated monthly, using precipitation, temperature and other data and is reported in BBMWD's annual Watermaster reports. Lake inflow is calculated monthly by the following formula: Inflow = Evaporation + Releases + Spills + Leakage + Net Withdrawals - Change in Storage. Inflow is calculated rather than measured (BBMWD 2002). Average annual inflow to Big Bear Lake

approximates 17,300 af and adjusted evaporation approximates 11,300 af based on Watermaster data from 1977-2001 (Table 1-1).

The State Water Resources Control Board adopted Order WR No. 95-4 to assure adequate flows downstream of the dam to protect fisheries in Bear Creek. Order WR No. 95-4 requires minimum outflows of 0.3 cfs at Station B (300 feet below Bear Valley Dam) and 1.2 cfs at Station A (West Cub Creek confluence with Bear Creek) (BBMWD 2002). Big Bear Lake is also utilized as a source of water for snow making operations. Snow Summit and Bear Mountain ski resorts can acquire a total of 1000 af of lake water per year (BBMWD 2002).

Table 1-1. Big Bear Lake statistics

Lake Elevation	6743.2 feet
Lake length	7 miles
Average lake width	½ mile
Shoreline	22 miles
Max depth at dam	72.33 feet
Max lake capacity	73,320 acre-feet
Big Bear Valley Length	12.5 miles
Average inflow	17,300 af/year
Average outflow at dam[1]	5,510 af/year
Average evaporation rate[2]	11,300 af/year
Average lake capacity	58,500 af/year
Average detention time of water (avg lake capacity/avg outflow at dam)	11 years

Source: BBMWD 2002; BBMWD 2004a

[1]Outflow includes dam releases, spills, leakage and withdrawals

[2]Evaporation is calculated with the Blaney Criddle formula using the estimated evaporation rate and the average surface area of the lake during the month (Big Bear Watermaster 2001, 6).

1.1 Big Bear Lake Watershed

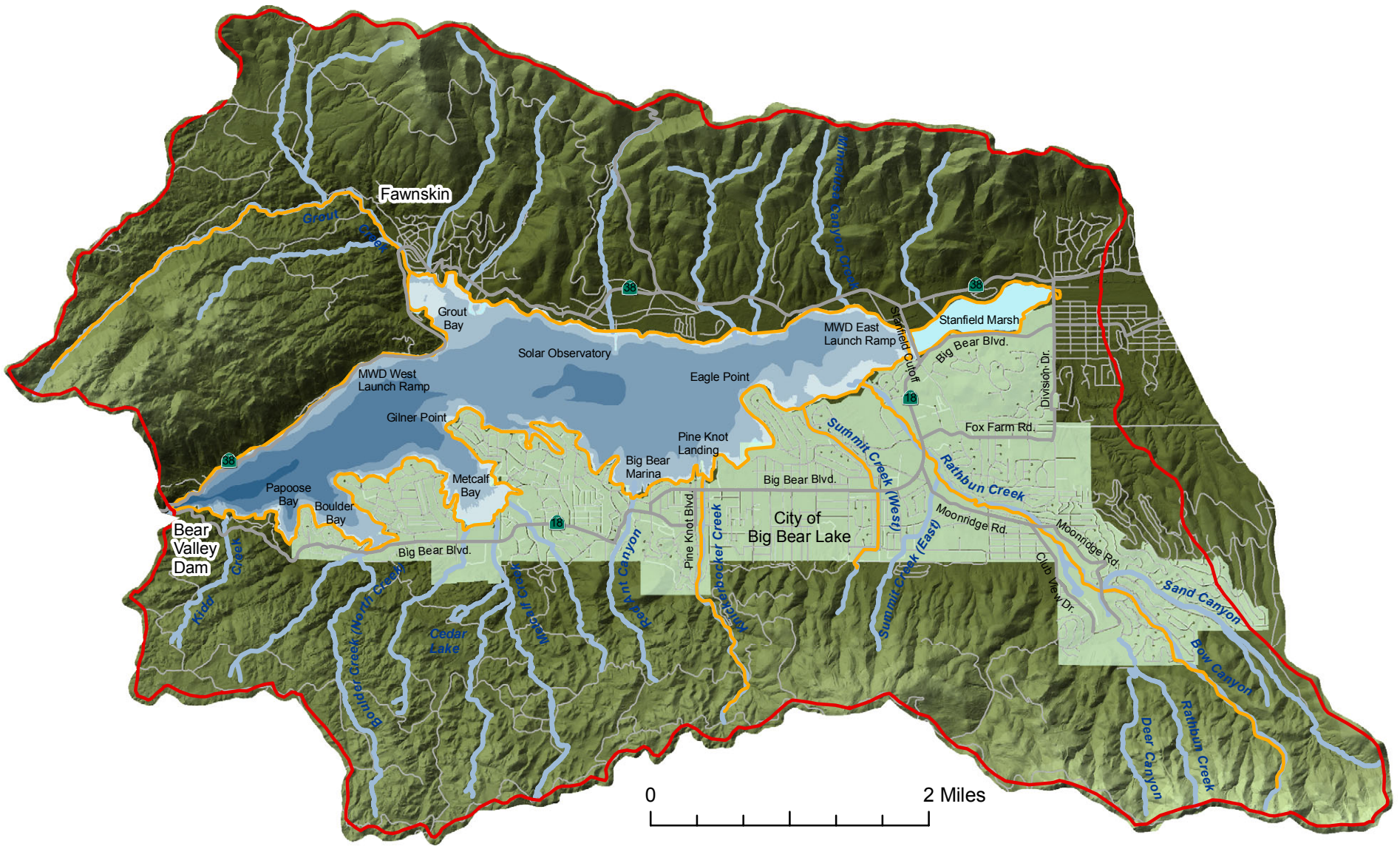
The Big Bear Lake watershed is approximately 37 square miles and is drained by more than 10 streams (Figure 1-1). Local stream runoff and precipitation on the lake are the water supply inputs to Big Bear Lake. Big Bear Lake drains to Bear Creek, which is tributary to the Santa Ana River. Twelve percent of Big Bear Lake's drainage basin consists of the lake itself.

The mountain peaks surrounding the Big Bear Basin rise to approximately 7,800-8,600 feet along the southern rim of the lake. Some prominent peaks include Butler Peak (8,537 feet) to the west, Bertha Peak (8,198 feet) to the north, and Snow Summit (8,470 feet) to the south. The watershed is dominated by yellow pine and white fir; junipers and pinyon pine are found on the drier slopes. The lower reaches of most of the Big Bear Lake tributaries, particularly those in the eastern area, are underlain with older and younger alluvium. The western portion and the upper eastern portions of the lake are dominated by undifferentiated basement complex rocks, which are mostly impervious.

The underlying groundwater basin is used for domestic water supply of the Big Bear Valley and is mined in three ways: wells drilled into alluvial deposits, bedrock slant wells, and springs. During the 1970s, the Big Bear Lake watershed was divided into seven hydrographic subareas which were "based essentially on drainage boundaries, to facilitate the description of the region and for the tabulation of pertinent data according to a geographic locale"(Neste, Brudin, and Stone Inc. 1973, 3-12). These hydrographic subareas are termed Village, Rathbone, Division, North Shore, Grout Creek, Mill Creek, and Gray's Landing (Neste, Brudin, and Stone Inc. 1973, 3-14) (Figure 1-2). The City of Big Bear Lake Department of Water and Power (DWP), established in 1989, obtains its water from local groundwater and provides domestic water service to the city and areas outside the city limits. The Division, Village and Rathbone (Rathbun) subareas provide groundwater used by the city (City of Big Bear Lake 1999, ER-31).

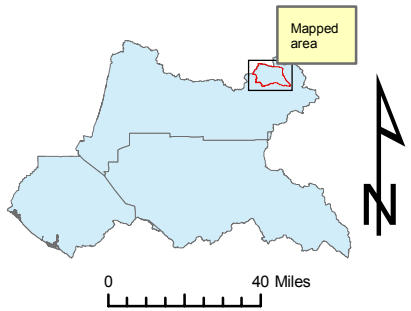
(A) Rathbun (Rathbone) Creek Subwatershed. The Rathbun Creek subwatershed is located in the Moonridge area south of Big Bear Lake. The subwatershed drains approximately 4090 acres of land (6.4 square miles), 30% within the City of Big Bear Lake and the remainder within the San Bernardino National Forest (Figure 1-3). There are four major drainages included in the Rathbun Creek subwatershed: Rathbun Creek, Deer Canyon, Sand Canyon, and Bow Canyon. Rathbun Creek is 3.5 miles long. The Rathbun Creek subwatershed is characterized by steep fluvial/V-shaped erosional and mildly sloping alluvial valley bottom types with elevations from 6700 to 8900 feet above sea level (USDA 1995, 1). Bear Mountain ski area is located in the upper reaches of Rathbun Creek, Deer Canyon and several unnamed drainages, while Snow Summit ski area is located within the headwaters of Summit Creek, which drains into the Rathbun Creek watershed. Most of the drainage area has been substantially altered by human activities. The paragraphs below describe the condition of Rathbun Creek from the confluence of Sand Canyon Channel to the mouth.

Sand Canyon Channel
Sand Canyon Channel merges with Rathbun Creek at Moonridge Road. This channel is an ephemeral stream dominated by snowmelt runoff. Soils in the area are coarse textured. The channel gradient is approximately 6 percent and is devoid of riparian vegetation. The channel is partially maintained by the San Bernardino County Flood Control District (SBCFCD) (USDA 1995, 3).



Water Boards

Data Sources:
Tributaries (modified by RWQCB 8),
Elevation - San Bernardino County, 2004
Watershed boundary - Hydmet, Inc., 2003
Lake bathymetry - ReMetrix, Inc., 2000
Section 303(d) listed water bodies - SWRCB, 2004
Major roads - San Bernardino County, 2004
City of Big Bear Lake boundary -
City of Big Bear Lake, 2002



Map Features

- Clean Water Act Section 303(d) listed bodies of water
- Major roads
- Big Bear Lake Tributaries
- City of Big Bear Lake boundary
- Big Bear Lake watershed boundary
- Streets

Big Bear Lake Bathymetry
DEPTH
- 69 - 51 feet
- 50 - 36 feet
- 35 - 21 feet
- 20 - 9 feet
- 8 - 1 feet

Figure 1-1. Big Bear Lake Watershed

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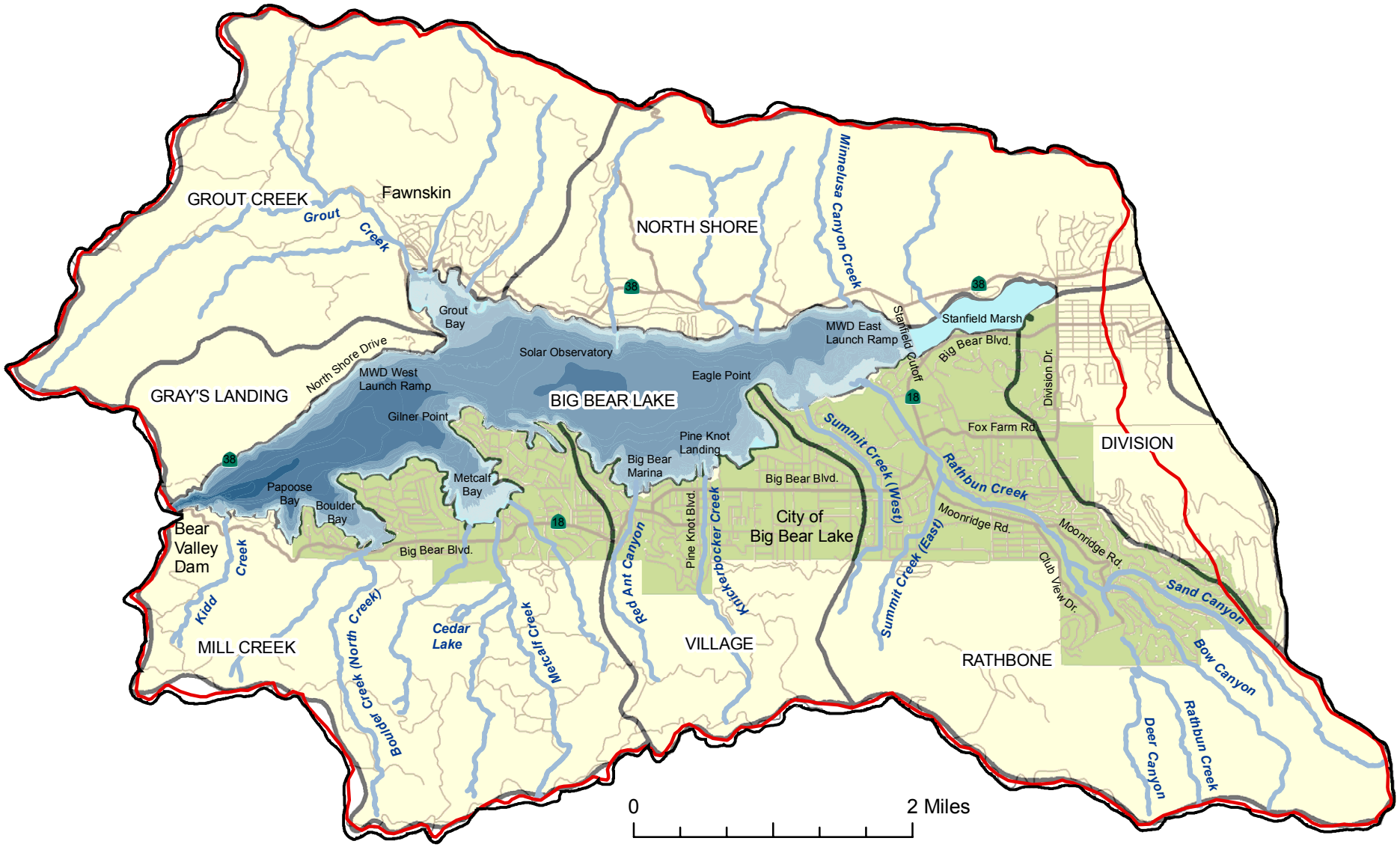
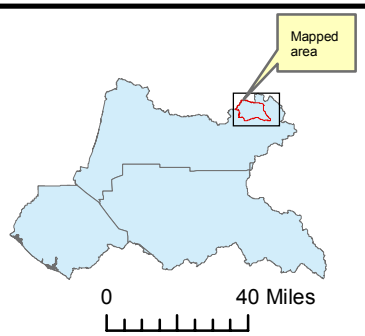
Map Contact: Heather Boyd, CA Regional Water Quality Control Board, Santa Ana Region, June 2005





Map Features

- Hydrographic subareas
- City of Big Bear Lake boundary
- Big Bear Lake watershed boundary
- Major roads
- Streets

Data Sources:
Tributaries (modified by RWQCB 8) - San Bernardino County, 2004
Watershed boundary - Hydmet, Inc., 2003
Lake bathymetry - ReMetrix, Inc., 2000
Major roads - San Bernardino County, 2004
City of Big Bear Lake boundary, Hydrographic subareas - City of Big Bear Lake, 2002

Figure 1-2. Hydrographic subareas

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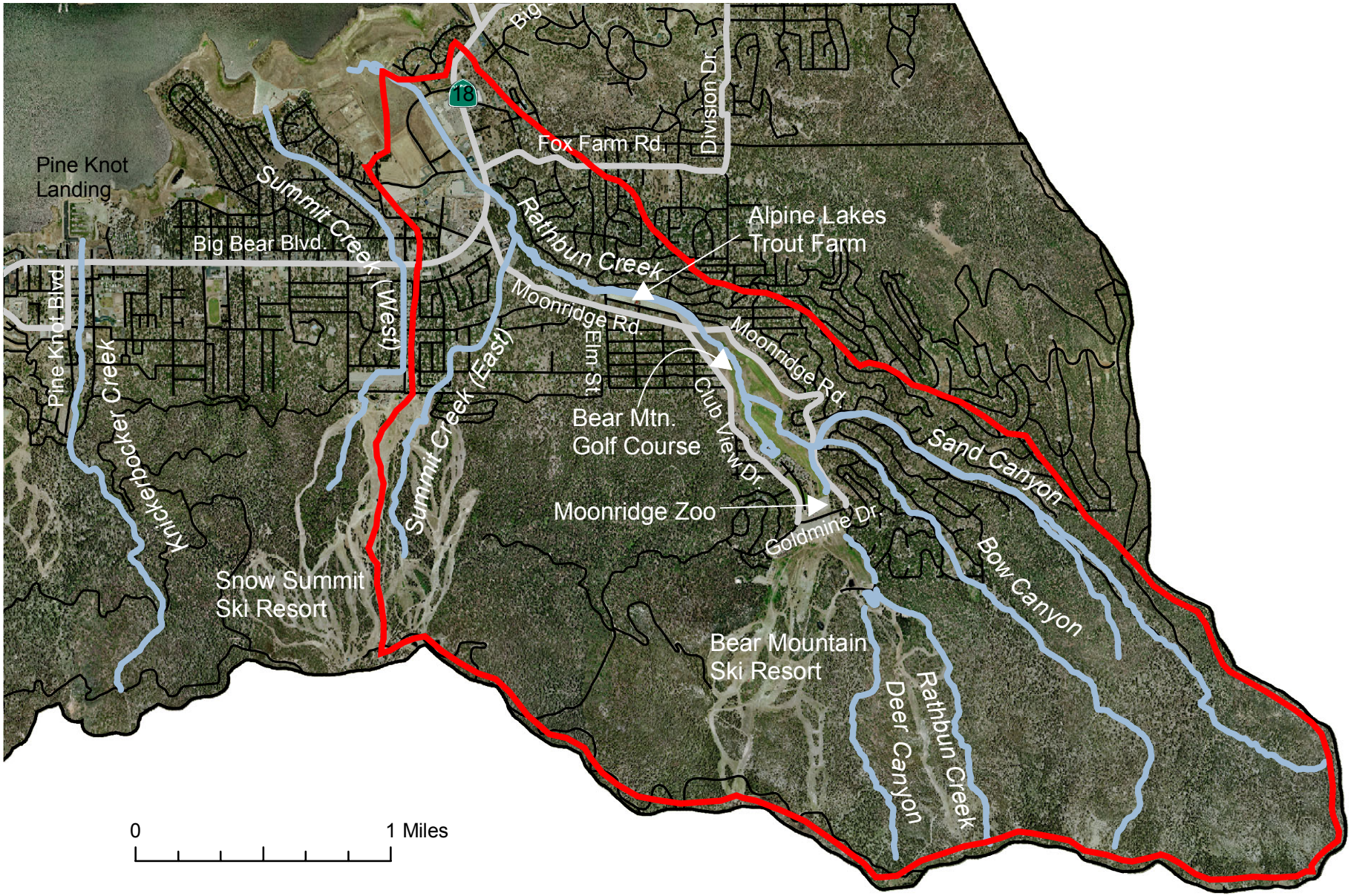
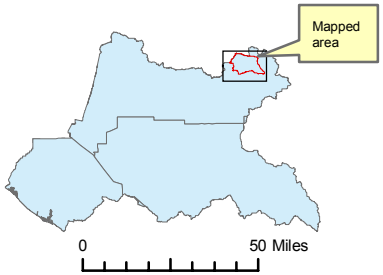
Map contact: Heather Boyd, CA Regional Water Quality Control Board, Santa Ana Region, June 2005



Water Boards

Data Sources:
Tributaries (modified by RWQCB 8), aerial imagery, major roads -
San Bernardino County, 2004
Watershed boundary - Hydmet, Inc., 2003



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Map Features

- Rathbun Creek Subwatershed boundary
- Big Bear Lake Tributaries
- Major roads
- Streets

Figure 1-3. Rathbun Creek Subwatershed

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Map contact: Heather Boyd, CA Regional Water Quality Control Board, Santa Ana Region, June 2005

Sand Canyon Channel has been widened to 40 feet with 2:1 side slopes for flood protection for the nearby homes. The channel is unlined alluvial sediment consisting of fine to coarse-grained sands and gravels with interbedded silt (Black and Veatch 1990, 7). This channel is experiencing streambed erosion and bank sloughing (USDA, 1995, p.3). Modifications to Sand Canyon Channel, consisting of armoring the banks about 600 feet upstream of Moonridge Road, were completed in 1997 with funds from a Clean Water Act Section 319(h) grant. In addition, supported by a Clean Water Act Section 319(h) grant awarded in 1999, the culvert at Teton Drive was replaced and the banks along the north and south sides of Teton Drive were armored. This project, located upstream of the first 319(h) project, was completed in 2002.

Rathbun Creek: Goldmine Road to Moonridge Road (Golf Course)

Historically, Rathbun Creek meandered, with flows from Sand and Bow Canyons joining the creek near the center of the valley. The upper portion of the creek was rerouted along the east side of the valley to allow for the golf course. This adjustment straightened the creek and in the process caused the creek to become entrenched (USDA 1995, 5). The 43-acre golf course was formerly a meadow (City of Big Bear Lake 1999, OPR-3). The Moonridge Zoo (2.7 acres) is located at the intersection of Moonridge and Goldmine Roads (City of Big Bear Lake 1999, OPR-3). Flow from the watershed area above Lassen Drive is directed into a culvert that outlets immediately below and to the west of the zoo. The lower portion of the creek, below the golf course to Moonridge Road, is a naturally meandering channel with a floodplain width between 30-50 feet. Horse grazing occurs below the golf course. Grazing has impaired the growth of riparian vegetation and contributes animal waste, high in nitrogen, which is discharged into the creek through surface runoff and leaching (USDA 1995, 5).

Rathbun Creek – Moonridge Road to the Trout Pond

A commercial trout pond (1 acre in size) is located within Rathbun Creek (City of Big Bear Lake 1999, OPR-3). Concrete check dams between Moonridge Road and Elm Road that serve as sediment traps are also effective as grade control structures. Below Elm Road there is a diversion that serves to divert moderate flows around the trout pond, while allowing low and high flows to continue flowing in the natural channel. Between Moonridge Road and the diversion downstream of Elm Road, the creek is straightened and channelized and consists of coarse loamy soils with an average channel slope of 2 percent (USDA 1995, 6-7).

Rathbun Creek – Trout Pond to State Highway 18

From the trout pond to Big Bear Boulevard (State Highway 18), the entire reach of Rathbun Creek is vegetated with tall shrub willows. After the installation of a 9x12 foot double box culvert under State Highway 18, a headcut developed in the upper section of this reach. Summit Creek drains the eastern edge of the Snow Summit Ski area. Runoff enters a trapezoidal concrete channel and flows through the residential area between the ski area and Moonridge Road. The creek (shown in Figure 1-3 as Summit Creek East) joins Rathbun Creek behind the Big Bear Inn through a 5x8 foot box culvert (USDA 1995, 8). A bank stabilization project was completed below the box culvert near the confluence of Summit and Rathbun Creeks in 1999. The banks were stabilized with rock and filter fabric (BBMWD 2002).

Rathbun Creek – State Highway 18 to Big Bear Lake

From State Highway 18 to Big Bear Lake, Rathbun Creek was historically a natural, meandering stream channel. The SBCFCD straightened and channelized the creek into an earth graded channel. Because of this channelization, sediment is not deposited throughout the floodplain but remains in creek flow and is deposited into the lake (USDA 1995, 9).

Bear Mountain Parking Areas

Two gravel overflow parking lots operated by Bear Mountain ski resort border Rathbun Creek. One parking lot covers approximately 20 acres and is bordered by Moonridge Road, Elm Road, and Rathbun Creek. The second parking lot is located upstream of the Trout Pond between Rathbun Creek and the diversion channel. This parking lot is approximately 5 acres in size. Plowed snow enters the creek. In addition, rain, ice melt, and snowmelt transport untreated sediment and pollutants into Rathbun Creek (USDA 1995, 16).

Climate. Precipitation varies greatly in the Big Bear area due to a rainshadow effect. The west end of the lake, near the dam, typically receives an average of 30-35 inches per year while at the east end of the lake, the average is less than 20 inches (Figure 1-4). The Big Bear Lake Dam weather station, established in 1883, has been monitoring precipitation continuously starting with the first precipitation records from the 1883-84 season. Information on other daily and hourly precipitation records in the San Bernardino Mountains is found in the modeling report (BBMWD, Hydmet, Inc. and AquAeTer, Inc. 2003).

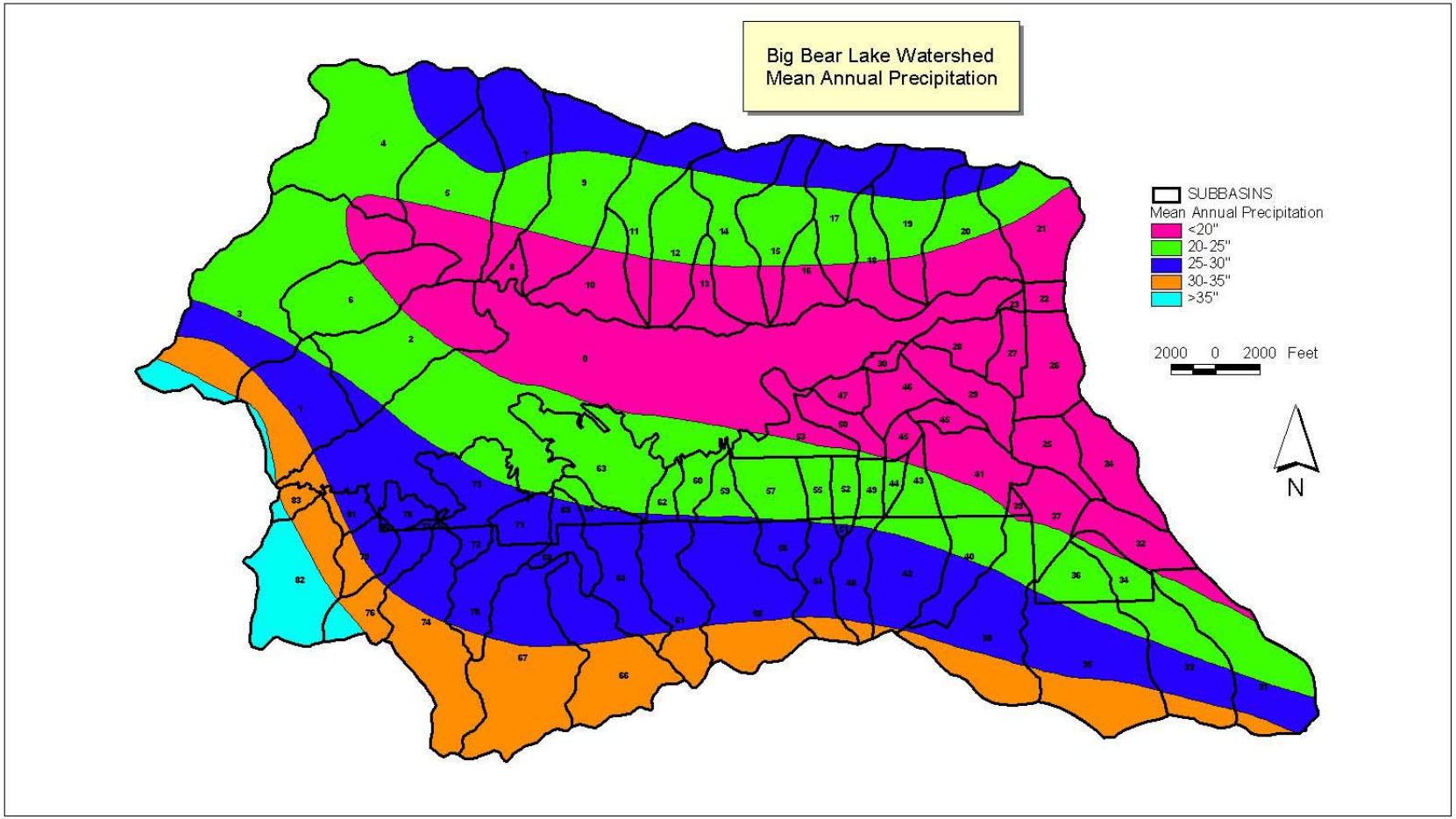

Figure 1-4: Mean annual precipitation for the Big Bear Lake watershed (source: BBMWD, Hydmet, Inc., and AquAeTer, Inc. 2003)

Figure 1-5 shows annual precipitation amounts, in inches per calendar year, measured at Bear Valley Dam. These annual numbers do not include snowfall, which does occur at this elevation. Most precipitation occurs from December through March, as indicated by monthly precipitation averages. Over a period of 56 years, the wettest year observed was in 1969 (Figure 1-5). Since the inception of the TMDL Task Force's[1] monitoring program (2001), recorded precipitation levels have been low. Consequently, lake levels, which are dependent upon surface runoff and direct precipitation, have also been extremely low (Figure 1-6).

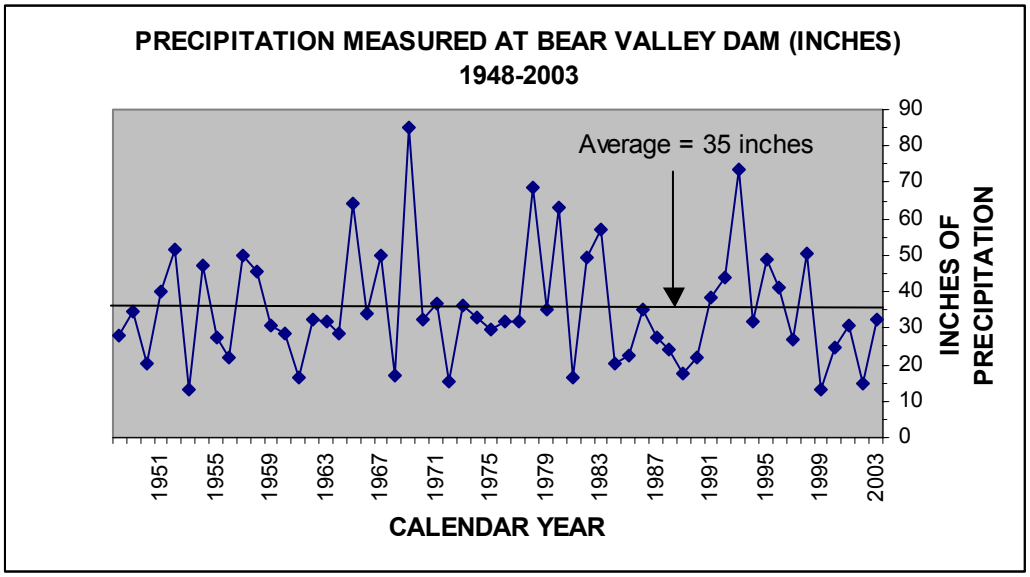

Figure 1-5. Annual precipitation, in inches, measured at Bear Valley Dam (Source: BBMWD 2004b)

[1] The TMDL Task Force was created by the Big Bear Municipal Water District in 2000. It consists of a number of local agencies and private interest groups including: the City of Big Bear Lake; San Bernardino County Flood Control District (SBCFCD); Big Bear Area Regional Wastewater Agency (BBARWA); Regional Board staff; Caltrans; Big Bear Mountain Resorts; the USFS; and others. BBMWD, acting on behalf of the Big Bear TMDL Task Force, has hired Tim Moore of Risk Sciences, Inc., as a consultant to develop and execute the appropriate studies to support TMDL development and to secure funding sources for the needed studies. The Task Force budget was created by a partnership of the BBMWD, the City of Big Bear Lake, SBCFCD, and BBARWA.

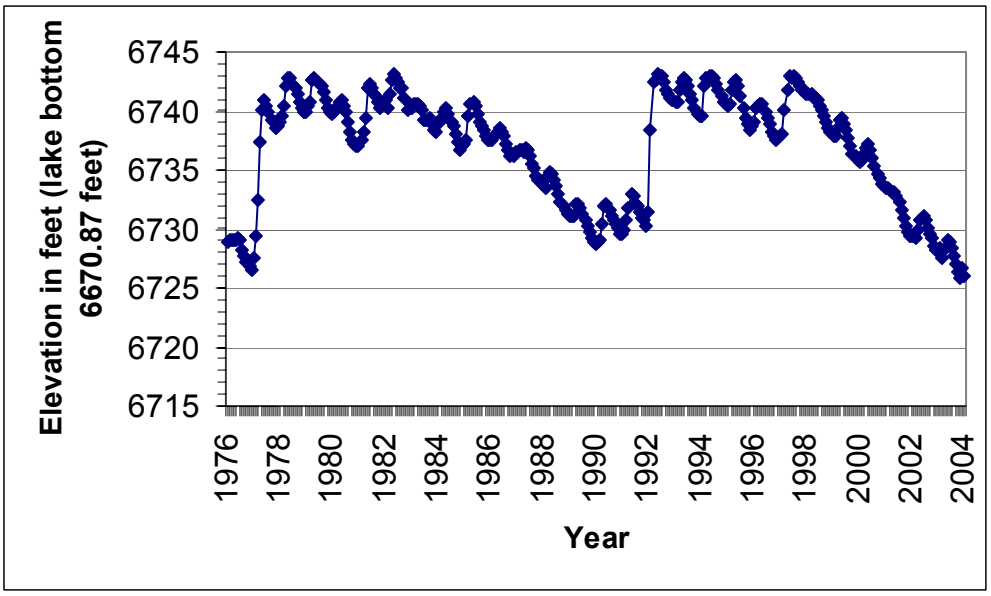

Figure 1-6: Lake elevation (in feet) for the period of record 1977- 2004 (full pool at 6743.2 feet) (Source: BBMWD 2004a)

Wastewater. Big Bear Area Regional Wastewater Agency (BBARWA), a joint powers authority created in 1974, provides interceptor service, secondary treatment and disposal by reclamation of all collected municipal wastewater in the Big Bear Valley (Engineering Resources of Southern California 1998, 1). The agency is located in Big Bear City and all the treated wastewater is disposed of in Lucerne Valley (Engineering Resources of Southern California 1998, 2). The sewerage system was installed in response to a prohibition on the use of subsurface disposal systems adopted by the Regional Board in 1973; there are limited exemptions to the prohibition, largely applicable to developments on large parcels outside existing sewer service area boundaries.

Land Use. The USFS is the largest landowner in the Big Bear area. The two ski resorts, Bear Mountain and Snow Summit, operate under special use permits from the USFS. Bear Mountain ski resort has 748 total permit acres; of that total, 198 acres are developed with 34 trails. The remaining acreage (550 acres) is undeveloped land that includes Deer, Goldmine and Bow Canyons (Bear Mountain Resort 2003). Snow Summit ski resort, built in 1952, is 620 acres in size, with 230 skiable acres (City of Big Bear Lake 1999, ER-24, OPR-6). Snow Summit is also used for mountain biking during the summer. A third abandoned ski resort, Snow Forest, is located to the southwest of Knickerbocker Creek. The San Bernardino Recreation Club and the Big Bear Lake Park District opened this area to skiing and tobogganing in 1939 (City of Big Bear Lake 1999, ER-24). This site is a contributor of sediment and potentially nutrients to Big Bear Lake.

The only incorporated city in the Big Bear Lake watershed is the City of Big Bear Lake, which was incorporated in 1980. The permanent population of the City of Big Bear Lake in 1980 was 4,923 and 6,049 in 1998. Of a total of 9,019 dwelling units in the City as of January 1, 1998, only 26% were permanently occupied. An estimated 50,000 or more people visit the City of Big Bear Lake on a peak holiday weekend and the U.S. Forest Service estimates 5 million people visit Big Bear Valley each year (City of Big Bear Lake 1999, LU-4, LU-6).